

1 We claim:

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- 3 1. A fiber node for deployment in a hybrid fiber-coax network (HFCN) at an
- 4 intermediate point between an upstream HFCN facility and a plurality of subscriber
- 5 cable modems, the fiber node comprising:
- 6 a) a packet protocol block having a packet data interface, a transmitter data
- 7 interface, and a receiver data interface, said packet protocol block
- 8 communicating subscriber cable modem data with said upstream HFCN
- 9 facility via said packet data interface;
- 10 b) a plurality of modulators transmitting data to said subscriber cable modems
- 11 via a downstream analog RF interface, said transmitted data being provided
- 12 by said packet protocol block via said transmitter data interface; and
- 13 c) a plurality of demodulators for extracting data from subscriber cable modems
- 14 received via an upstream analog RF interface, said extracted data being
- 15 provided to said packet protocol block via said receiver data interface.
- 16
- 17 2. The fiber node of claim 1, wherein the cable modems are compatible with the
- 18 DOCSIS standard.
- 19
- 20 3. The fiber node of claim 1, wherein the upstream facility is a head end.
- 21
- 22 4. The fiber node of claim 1, wherein the upstream facility is a secondary head end.
- 23
- 24 5. The fiber node of claim 1, wherein the upstream facility is a hub.
- 25

- 1 6. The fiber node of claim 1, wherein channel separation is performed prior to the
2 demodulators such that multiple channels are extracted from each physical
3 transmission path of the upstream analog RF interface.
4
- 5 7. The fiber node of claim 1, further including at least one digitizing framer for
6 digitizing modulated signals as received via an upstream analog RF interface, said
7 digitized modulated signal data being provided to said packet protocol block via said
8 receiver data interface.
9
- 10 8. The fiber node of claim 7, wherein the cable modems are compatible with the
11 DOCSIS standard and the modulated signals are legacy telephone signals.
12
- 13 9. The fiber node of claim 7, wherein the extracted data and the digitized modulated
14 signal data are merged in said packet protocol block for communication over a
15 common packet transmission path with the upstream facility.
16
- 17 10. The fiber node of claim 8, wherein the extracted DOCSIS cable modem data and the
18 digitized legacy telephone data are communicated with said upstream facility via a
19 common Ethernet-compatible transmission path.
20
- 21 11. The fiber node of claim 7, wherein channel separation is performed prior to the
22 digitizing framer, such that at least one selected channel and only selected channels
23 are communicated with said upstream facility.
24
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- 1 12. The fiber node of claim 11, wherein the channel separation is performed in the digital
2 domain after analog-to-digital conversion.
3
- 4 13. The fiber node of claim 12, wherein the digitized modulated signal data is
5 compressed prior to being communicated to said upstream facility.
6
- 7 14. The fiber node of claim 9, wherein reconstruction of the digitized modulated signals
8 is performed at the upstream facility.
9
- 10 15. The fiber node of claim 12, wherein a plurality of selected non-contiguous channels
11 having respective modulated signals are concurrently separated and framed, merged
12 together for communication over a common Ethernet-compatible transmission path,
13 and subsequently separated and concurrently reconstructed at the upstream facility.
14
- 15 16. The fiber node of claim 15, wherein the upstream facility is a head end.
16
- 17 17. The fiber node of claim 16, wherein the cable modems are compatible with the
18 DOCSIS standard and the modulated signals are legacy telephone signals.
19
- 20 18. The fiber node of claim 15, wherein the upstream facility is a secondary head end.
21
- 22 19. The fiber node of claim 18, wherein the cable modems are compatible with the
23 DOCSIS standard and the modulated signals are legacy telephone signals.
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- 1 20. The fiber node of claim 15, wherein the upstream facility is a hub.
- 2
- 3 21. The fiber node of claim 20, wherein the cable modems are compatible with the
- 4 DOCSIS standard and the modulated signals are legacy telephone signals.
- 5
- 6 22. The fiber node of claim 6, wherein the channel separation is performed in the digital
- 7 domain after analog-to-digital conversion.
- 8
- 9 23. The fiber node of claim 22, wherein the channel separation is performed by digital
- 10 receivers with programmable center frequency and bandwidth.
- 11
- 12 24. The fiber node of claim 23, wherein the receivers are programmed by sending
- 13 commands to the fiber node via the packet data interface.
- 14
- 15 25. The fiber node of claim 24, wherein the fiber node is an mFN.
- 16
- 17 26. The fiber node of claim 1, further including analog combine and split circuitry
- 18 coupled to the upstream analog RF interface, the downstream analog RF interface,
- 19 and to the subscriber cable modems.
- 20
- 21 27. The fiber node of claim 26, wherein the analog combine and split circuitry is coupled
- 22 to the subscriber cable modems via a coaxial-cable distribution.
- 23
- 24
- 25

1 28. A hybrid fiber-coax network (HFCN) system, comprising:

- 2 a) an upstream HFCN facility;
- 3 b) a plurality of subscriber cable modems;
- 4 c) a first plurality of fiber nodes at intermediate points between said upstream
- 5 HFCN facility and said plurality of subscriber cable modems, at least a second
- 6 plurality of said first plurality of fiber nodes have an integral Cable Modem
- 7 Termination System (CMTS), each CMTS communicating with at least some
- 8 of said plurality of cable modems via analog RF, each CMTS communicating
- 9 subscriber cable modem data with said upstream HFCN facility via packet
- 10 data.

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12 29. The HFCN system of claim 28, wherein the CMTS comprises:

- 13 a) a packet protocol block having a packet data interface, a transmitter data
- 14 interface, and a receiver data interface, said packet protocol block
- 15 communicating subscriber cable modem data with said upstream HFCN
- 16 facility via said packet data interface;
- 17 b) a plurality of modulators transmitting data to said subscriber cable modems
- 18 via a downstream analog RF interface, said transmitted data being provided
- 19 by said packet protocol block via said transmitter data interface; and
- 20 c) a plurality of demodulators for extracting data from subscriber cable modems
- 21 received via an upstream analog RF interface, said extracted data being
- 22 provided to said packet protocol block via said receiver data interface.

23
24 30. The HFCN system of claim 29, wherein the cable modems are compatible with the
25 DOCSIS standard.

- 1 31. The HFCN system of claim 29, wherein the upstream facility is a head end.
2
- 3 32. The HFCN system of claim 29, wherein the upstream facility is a secondary head
4 end.
5
- 6 33. The HFCN system of claim 29, wherein the upstream facility is a hub.
7
- 8 34. The HFCN system of claim 29, wherein channel separation is performed prior to the
9 demodulators such that multiple channels are extracted from each physical
10 transmission path of the upstream analog RF interface.
11
- 12 35. The HFCN system of claim 29, wherein the CMTS further includes at least one
13 digitizing framer for digitizing modulated signals as received via an upstream analog
14 RF interface, said digitized modulated signal data being provided to said packet
15 protocol block via said receiver data interface.
16
- 17 36. The HFCN system of claim 35, wherein the cable modems are compatible with the
18 DOCSIS standard and the modulated signals are legacy telephone signals.
19
- 20 37. The HFCN system of claim 35, wherein the extracted data and the digitized
21 modulated signal data are merged in said packet protocol block for communication
22 over a common packet transmission path with the upstream facility.
23

- 1 38. The HFCN system of claim 36, wherein the extracted DOCSIS cable modem data
2 and the digitized legacy telephone data are communicated with said upstream facility
3 via a common Ethernet-compatible transmission path.
4
- 5 39. The HFCN system of claim 35, wherein channel separation is performed prior to the
6 digitizing framer, such that at least one selected channel and only selected channels
7 are communicated with said upstream facility.
8
- 9 40. The HFCN system of claim 39, wherein the channel separation is performed in the
10 digital domain after analog-to-digital conversion.
11
- 12 41. The HFCN system of claim 40, wherein the digitized modulated signal data is
13 compressed prior to being communicated to said upstream facility.
14
- 15 42. The HFCN system of claim 37, wherein reconstruction of the digitized modulated
16 signals is performed at the upstream facility.
17
- 18 43. The HFCN system of claim 40, wherein a plurality of selected non-contiguous
19 channels having respective modulated signals are concurrently separated and framed,
20 merged together for communication over a common Ethernet-compatible
21 transmission path, and subsequently separated and concurrently reconstructed at the
22 upstream facility.
23
- 24 44. The HFCN system of claim 43, wherein the upstream facility is a head end.
25

1 45. The HFCN system of claim 44, wherein the cable modems are compatible with the
2 DOCSIS standard and the modulated signals are legacy telephone signals.

3
4 46. The HFCN system of claim 43, wherein the upstream facility is a secondary head
5 end.

6
7 47. The HFCN system of claim 46, wherein the cable modems are compatible with the
8 DOCSIS standard and the modulated signals are legacy telephone signals.

9
10 48. The HFCN system of claim 43, wherein the upstream facility is a hub.

11
12 49. The HFCN system of claim 48, wherein the cable modems are compatible with the
13 DOCSIS standard and the modulated signals are legacy telephone signals.

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15 50. The HFCN system of claim 34, wherein the channel separation is performed in the
16 digital domain after analog-to-digital conversion.

17
18 51. The HFCN system of claim 50, wherein the channel separation is performed by
19 digital receivers with programmable center frequency and bandwidth.

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21 52. The HFCN system of claim 51, wherein the receivers of each CMTS are programmed
22 by sending commands to the respective packet data interface of each CMTS.

1 53. The HFCN system of claim 52, wherein at least one of fiber nodes having a CMTS is
2 an mFN.

3
4 54. The HFCN system of claim 29, further including analog combine and split circuitry
5 coupled to the upstream analog RF interface, the downstream analog RF interface,
6 and to the subscriber cable modems.

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8 55. The HFCN system of claim 54, wherein the analog combine and split circuitry is
9 coupled to the subscriber cable modems via a coaxial-cable distribution.

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